Predictive analytics in Sensor (IoT) Data

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Institute for Computer Science and Control

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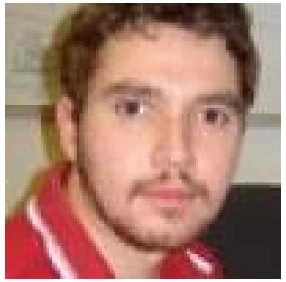

March 20, 2018

Big Data – Lendület kutatócsoport

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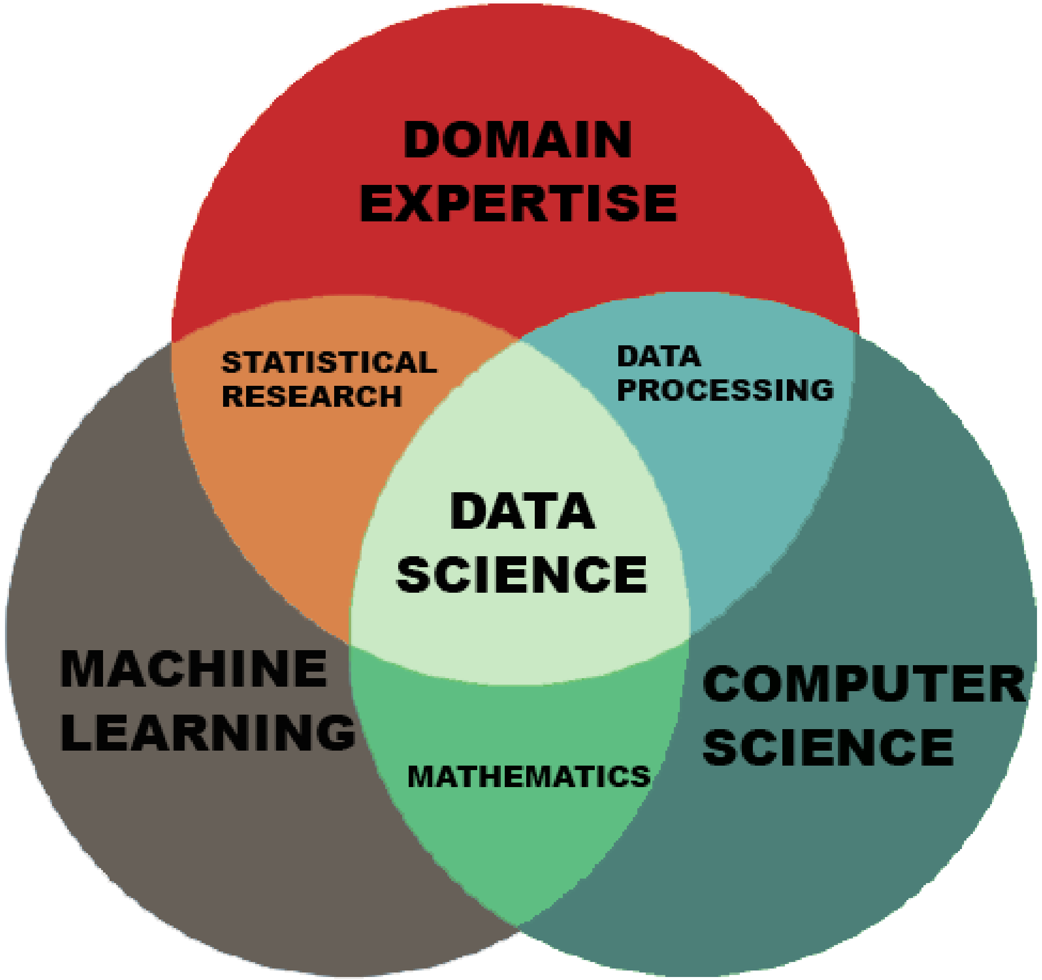
- Összesen 6 műszaki/informatika Lendület csoport
- Lendület támogatás a költségvetés ~15%-a, ~ 40% közvetlen szerződés, 20-20% hazai és EU, 5% SZTAKI belső erőforrás
- Teljes innovációs lánc, kutatástól alkalmazásokig

Alkalmazási területeink

- AEGON
  - 40 millió ügyfélrekord duplikátum-mentesítése az éles ügyfél rendszerben
  - Csalásfelderítő eszköz
- OTP
  - Gépi tanulási eljárások alkalmazásában elnyert tender
  - Orosz, Román ügyfelekre hitelnemfizetés, hitelkártya viselkedés modellezés
  - 9Md tranzakció hálózatában kockázat-terjedés modellezés
- Ericsson
  - Mobil session drop, Quality of Experience predikció
  - Data Streaming analitika, világméretű IoT Data Hub prototípus
- Bosch
  - Gyártósori szenzor adatok alapján minőségi problémák előrejelzése, root cause analízis
- Telekom, Vodafone, Clickshop: kereső technológia



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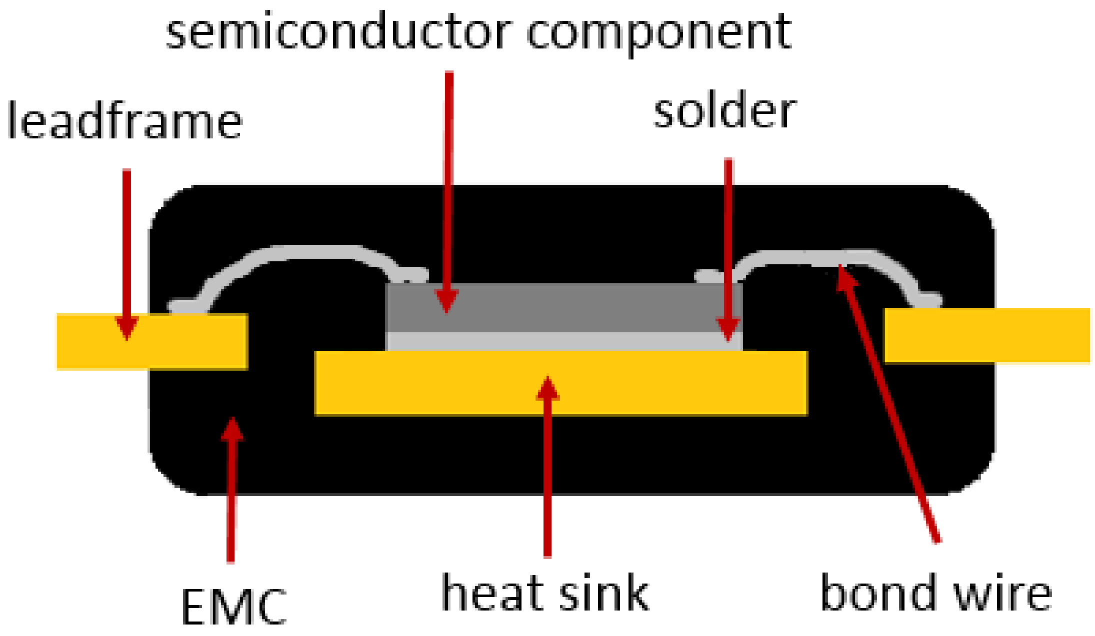
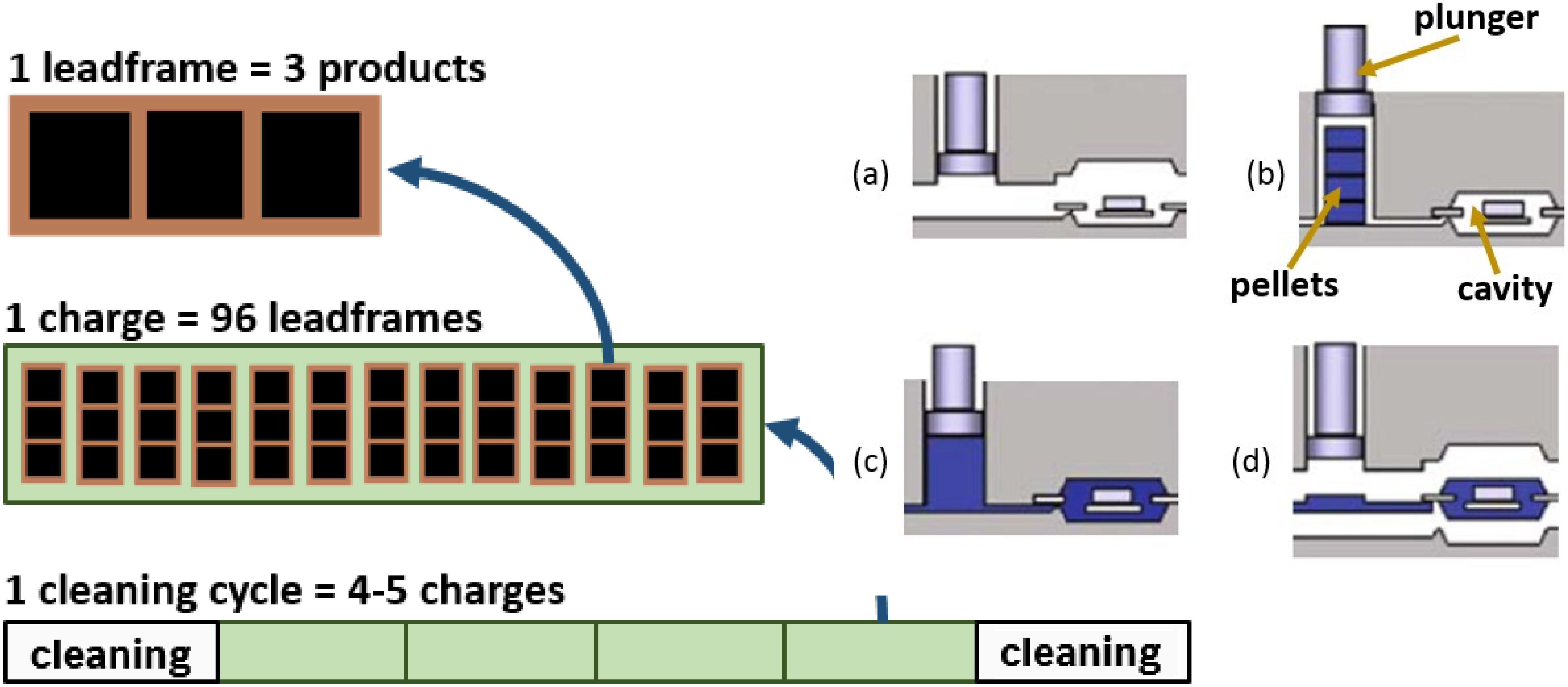
Use case 1: scrap rate prediction in transfer molding

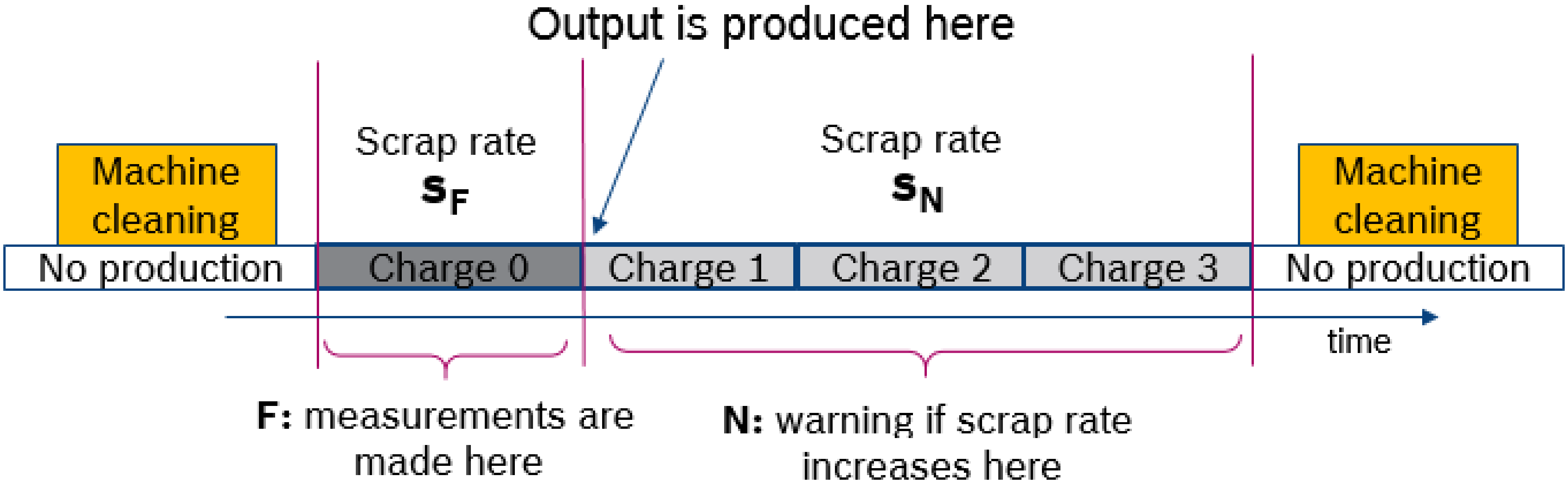
BOSCH



Cleaning cycles

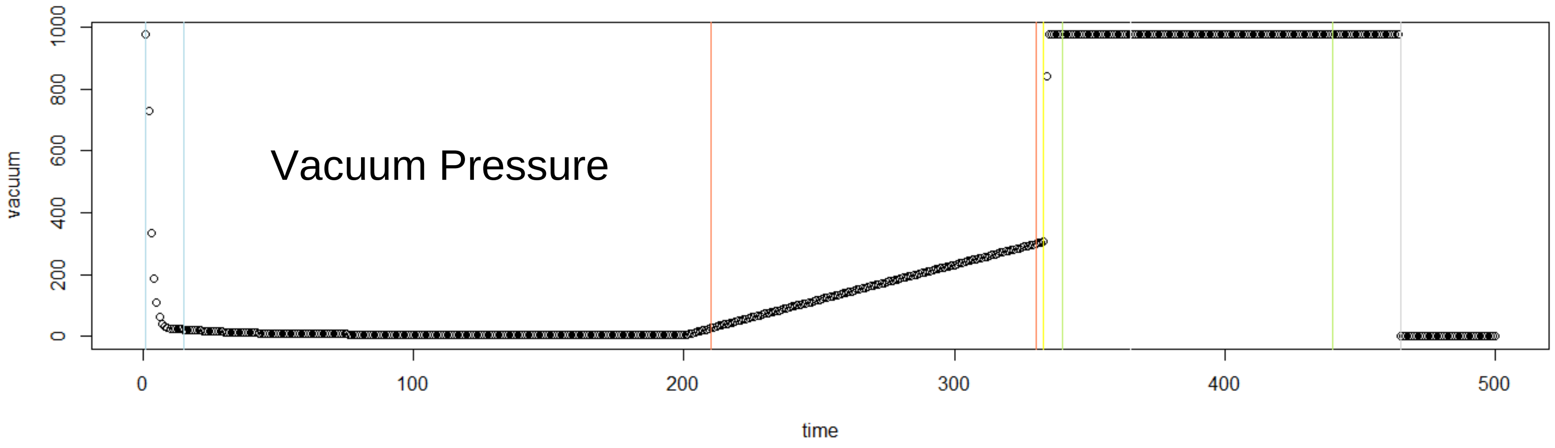


Scrap rate prediction task

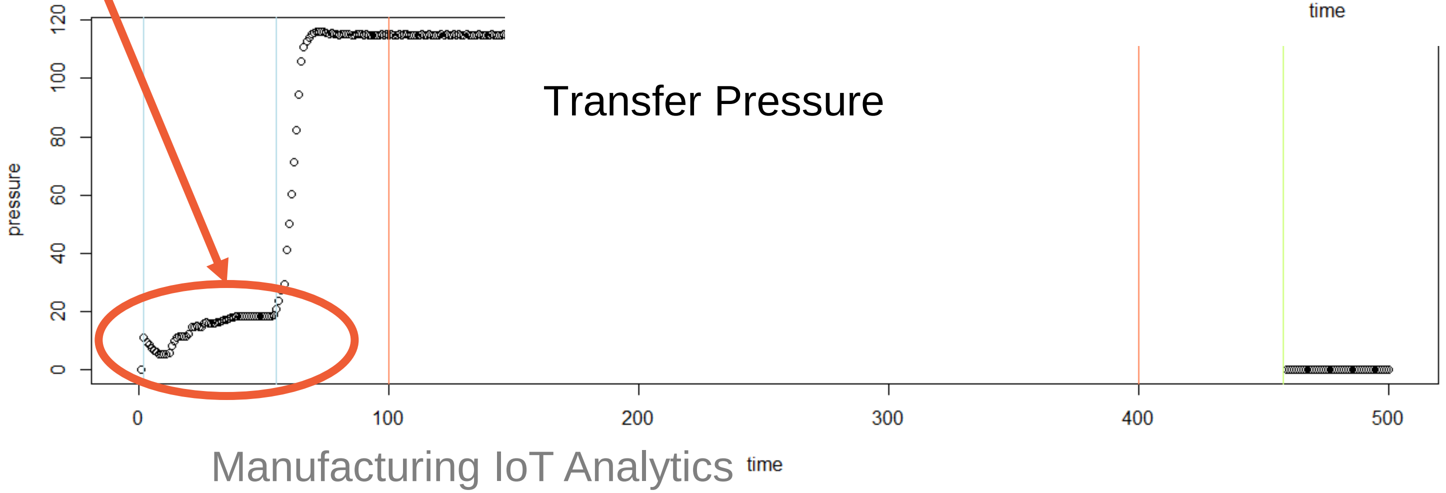


Data

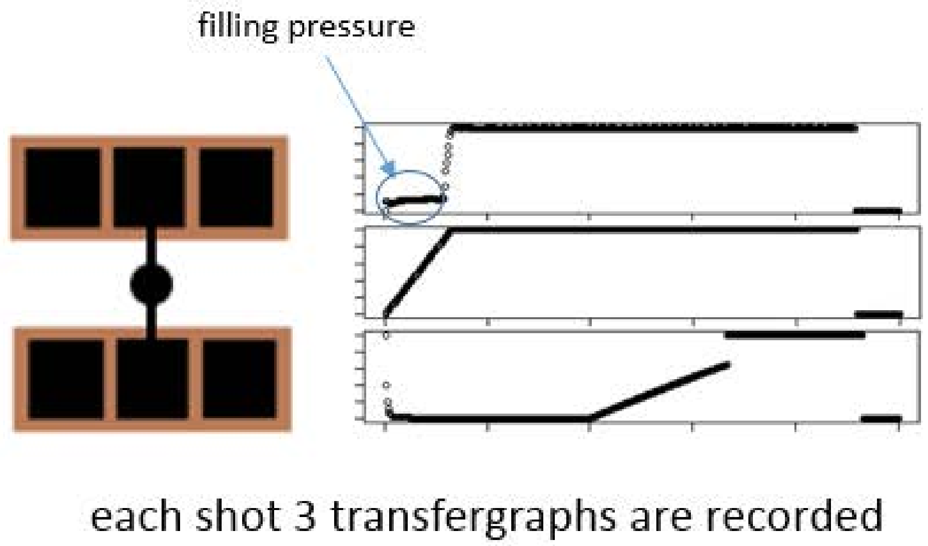
- Multiple time series, 500+ measurements in each: many, many data points
- Features of mean, variance, differentials, distribution of transfer graph data points
- In the end, ~50 features in the final classification data

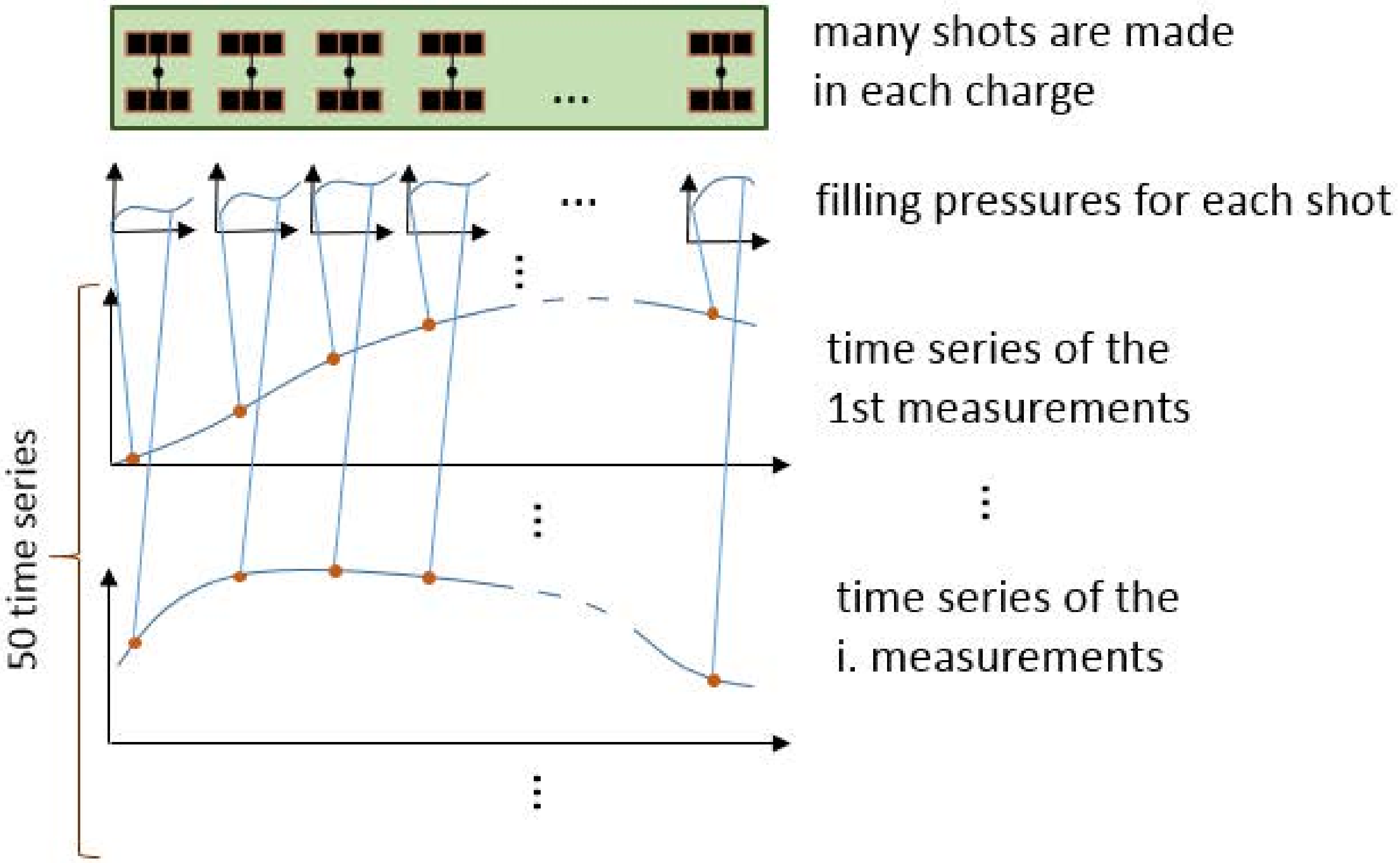


Filling pressure



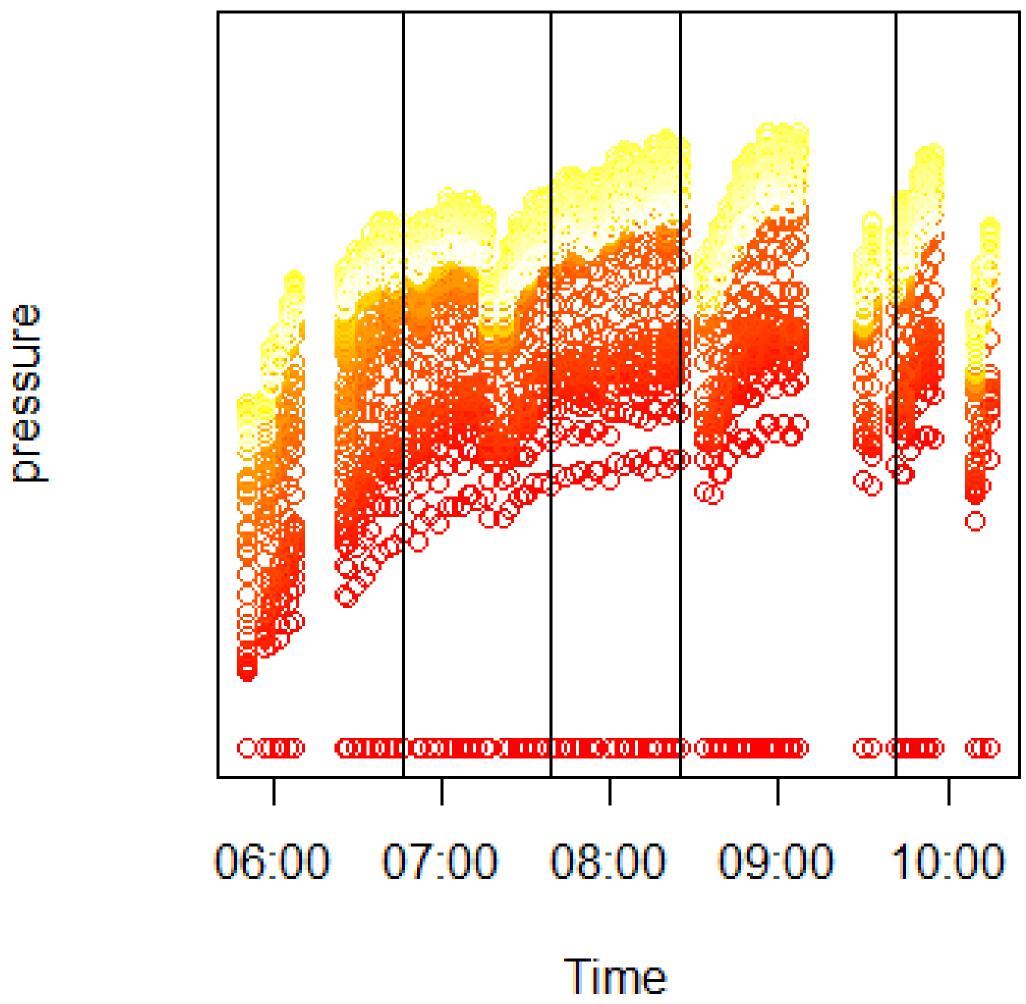
Time series of time series





Series of pressure series

- Filling pressure measurements
- Red to yellow color scale: measurement 1 – 50
- Vertical lines: new charges
- **Important to notice**
  - Values are lower after machine cleaning, and later they typically increase
  - Pressure is indirectly measured on the plunger
  - Contamination modifies pressure measurement



Summary

Facts:

6-10,000 products/hour
Few 100 data points per product
100> failed products in a day

Available for several months:

Delamination, Void, … failures

- First line reject
- Second line reject
- Failures at later stages

Machine logs

- BottomPreheatTemperature1-6
- BottomToolTemperature
- UpperToolTemperature
- LoaderTemperature
- PreheatTime
- toolData[1-2].value
- TransferPressGraphPos1-150
- TransferSpeed1-10
- TransferTime
- TransferVacuum

Root Cause Analysis

Transfer pressure measured indirectly

- includes friction from valves
- certain points in the time series indicate contamination

Vacuum pressure has no direct effect, but …

- Differences in trays: calibration problems
- Vacuum drop speed: leakage and blinding
- May result in less effective cleaning?

Result in variables that affect the production in indirect way that needs to be understood

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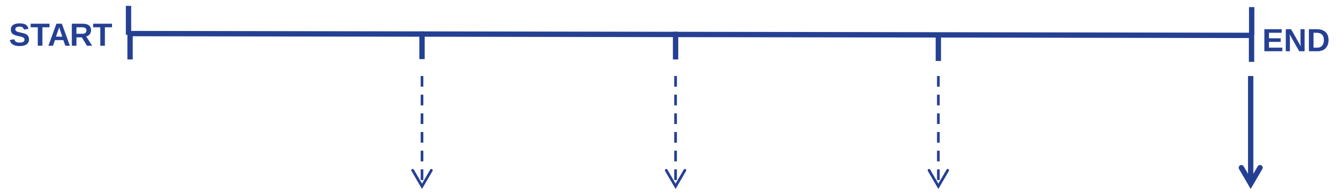
Use Case 2: Mobile radio session drop

ERICSSON

Data is based on eNodeB CELLTRACE logs from a live LTE (4G) network

RRC connection setup /
Successful handover into the cell

UE context release/
Successful handover out of the cell

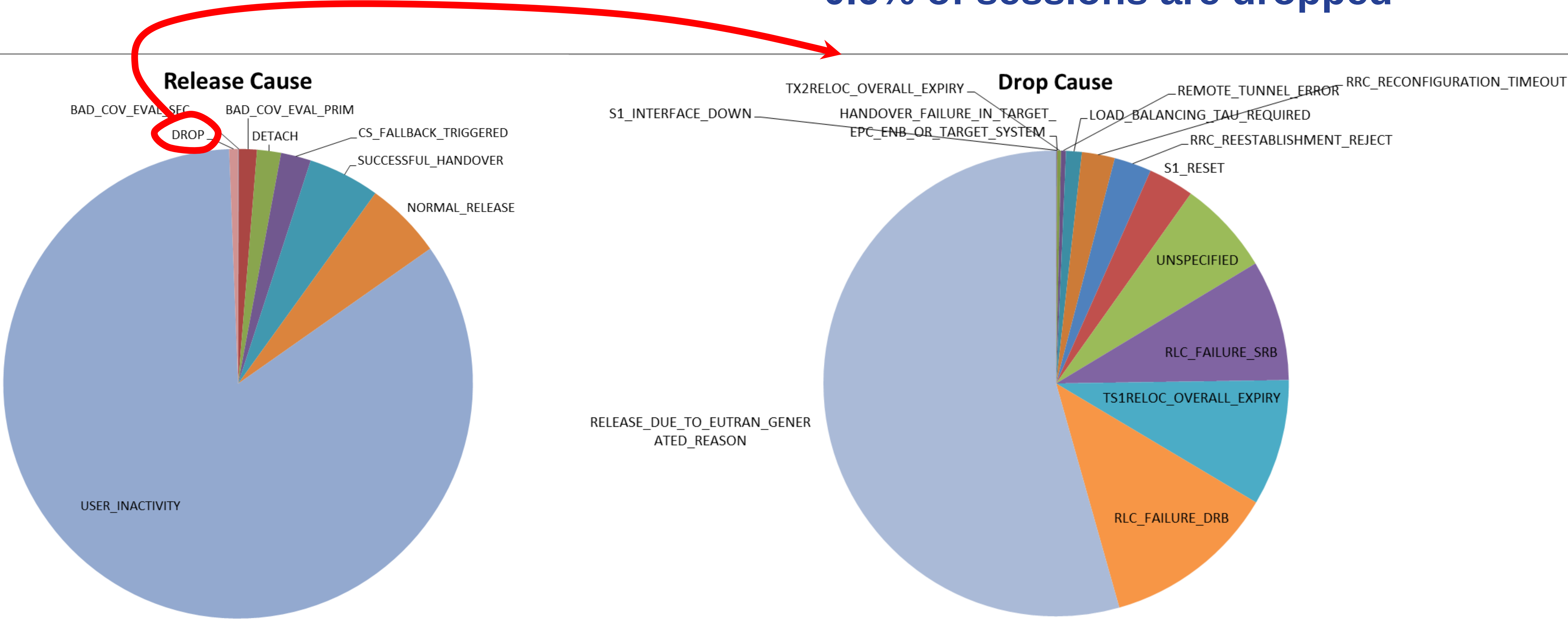


Per UE traffic report
(traffic volumes, protocol events (HARQ, RLC))
Per radio UE measurement
(CQI, SINR)
Period: 1.28s

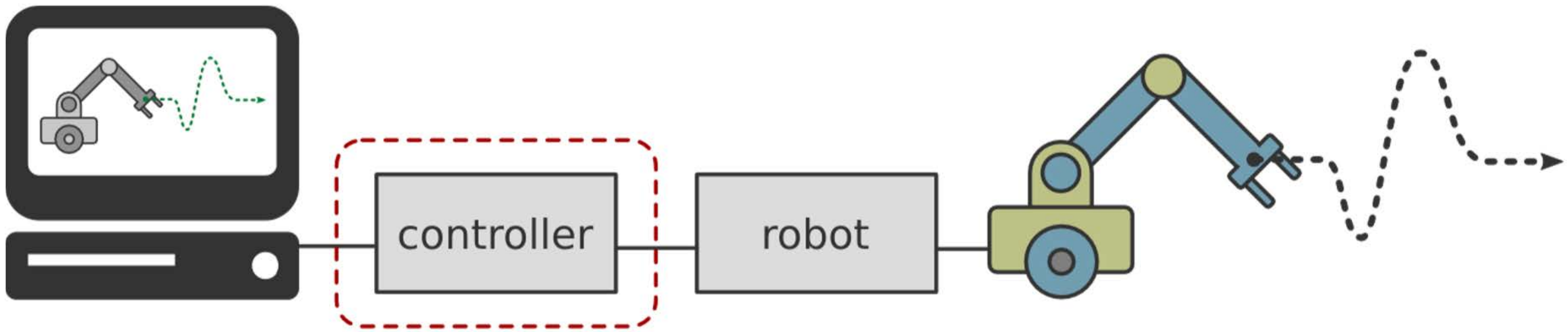
Per UE measurement reports
(RSRP, neighbor cell RSRP list)
Configurable period
Not available in this analysis

Root-cause analysis: Cause of Release and Drop

0.6% of sessions are dropped



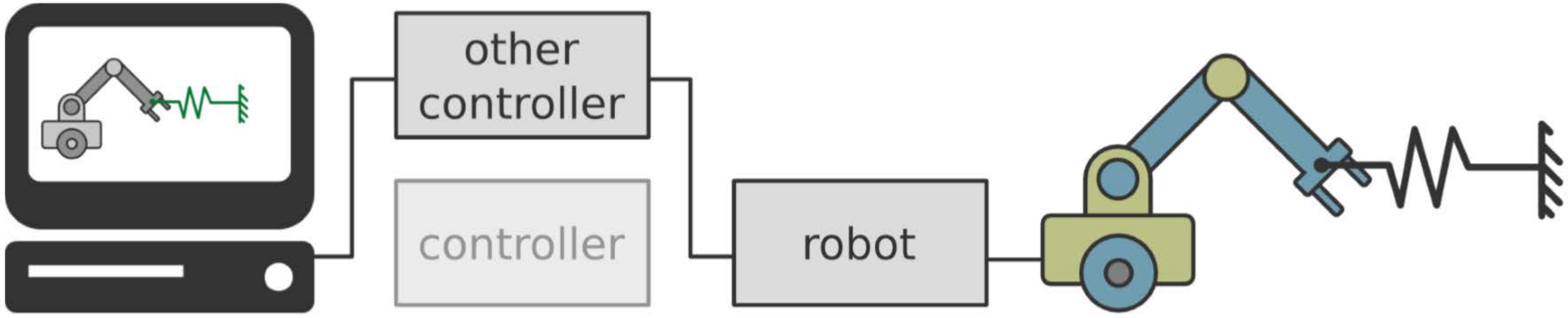
Latency critical communication with unreliable links



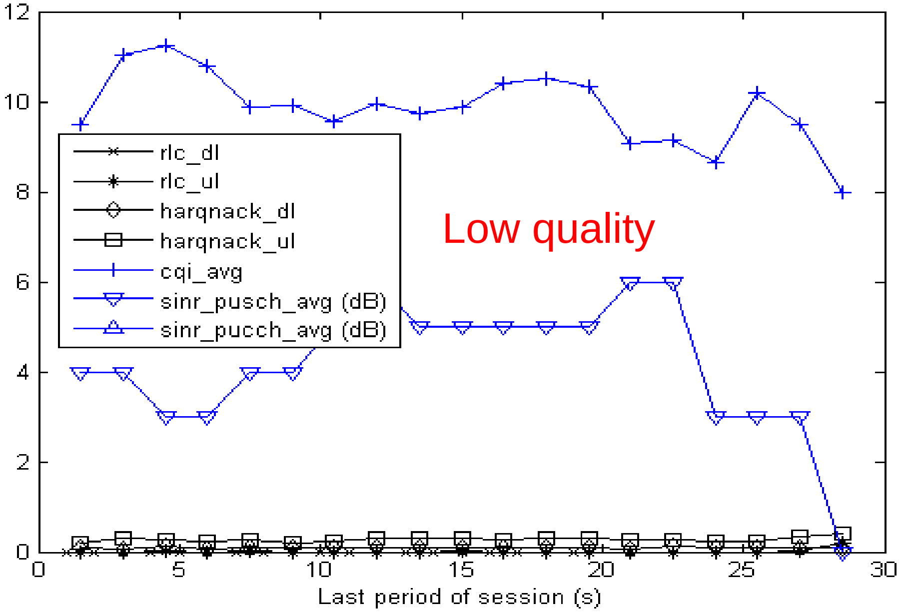
Detect network issues, predict problems ahead in time to prepare alternate control route

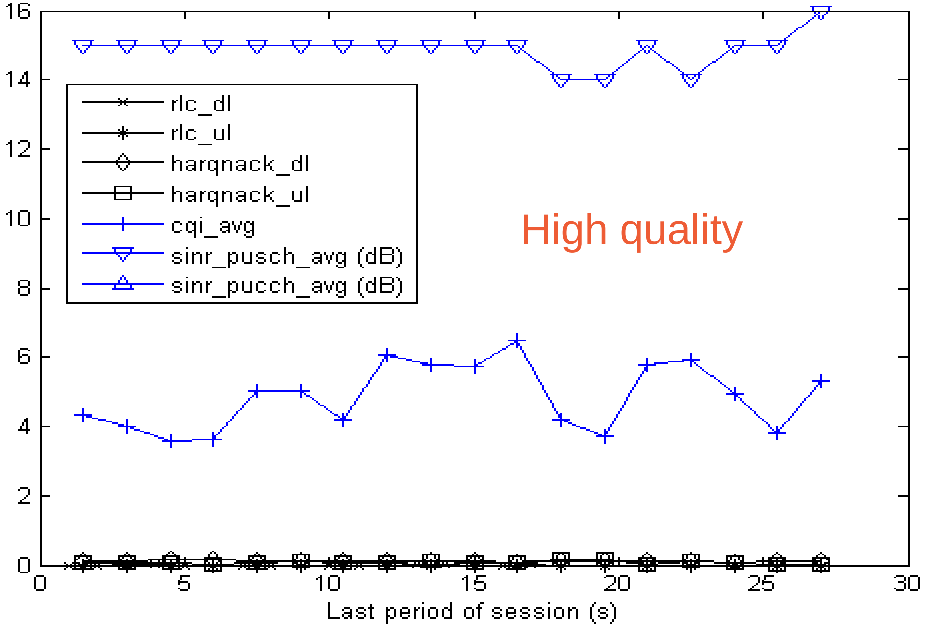
Make stable and reliable re-routing decisions in case of jitter

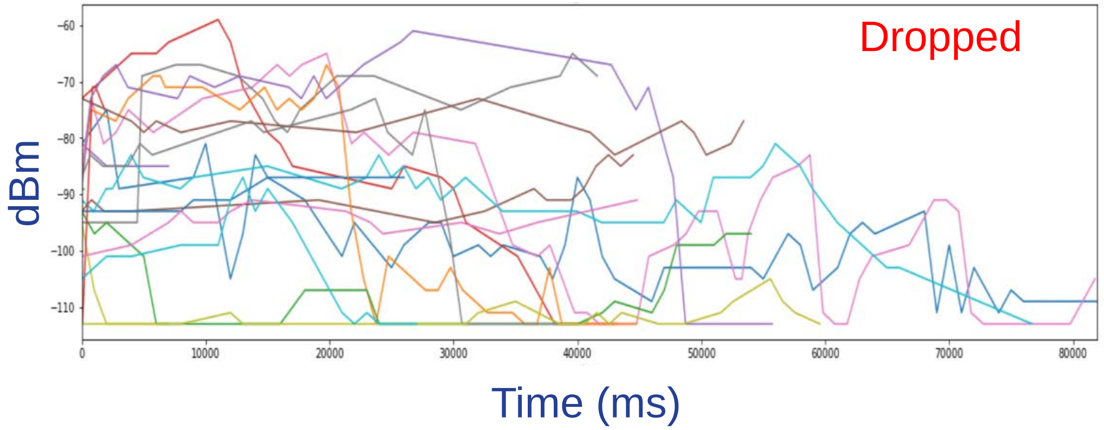
Reroute traffic for robot control and other real time applications

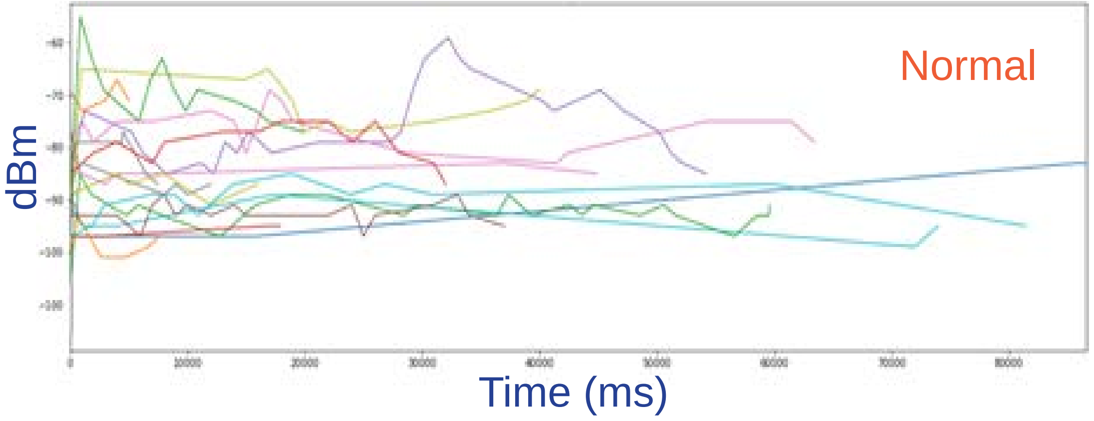


Examples for low quality and loss





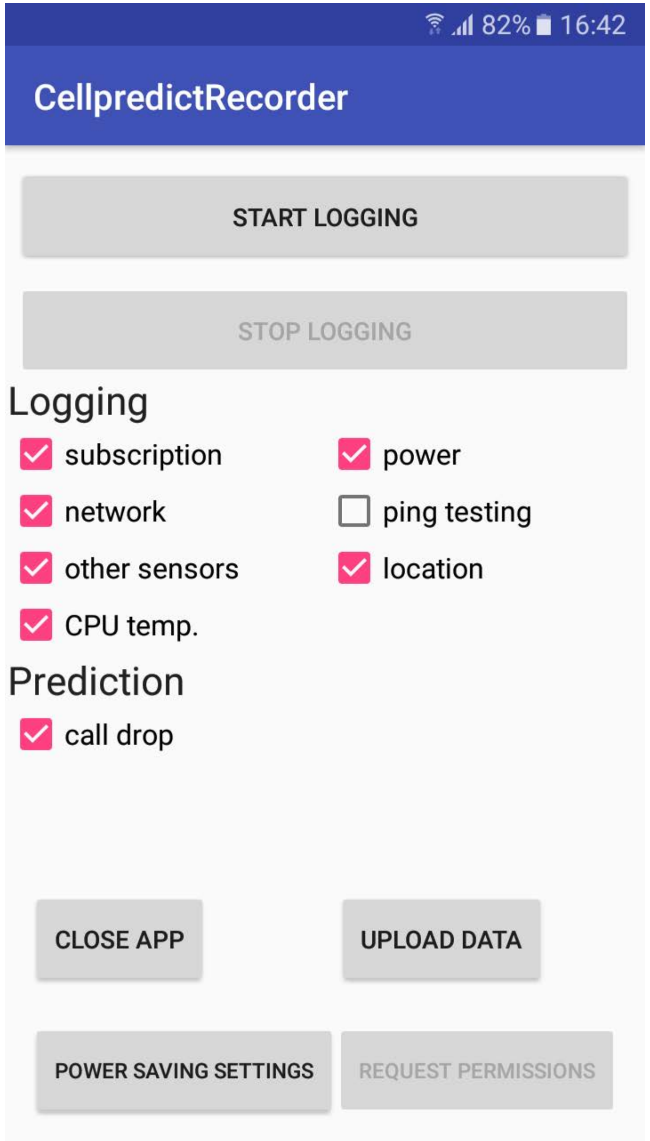




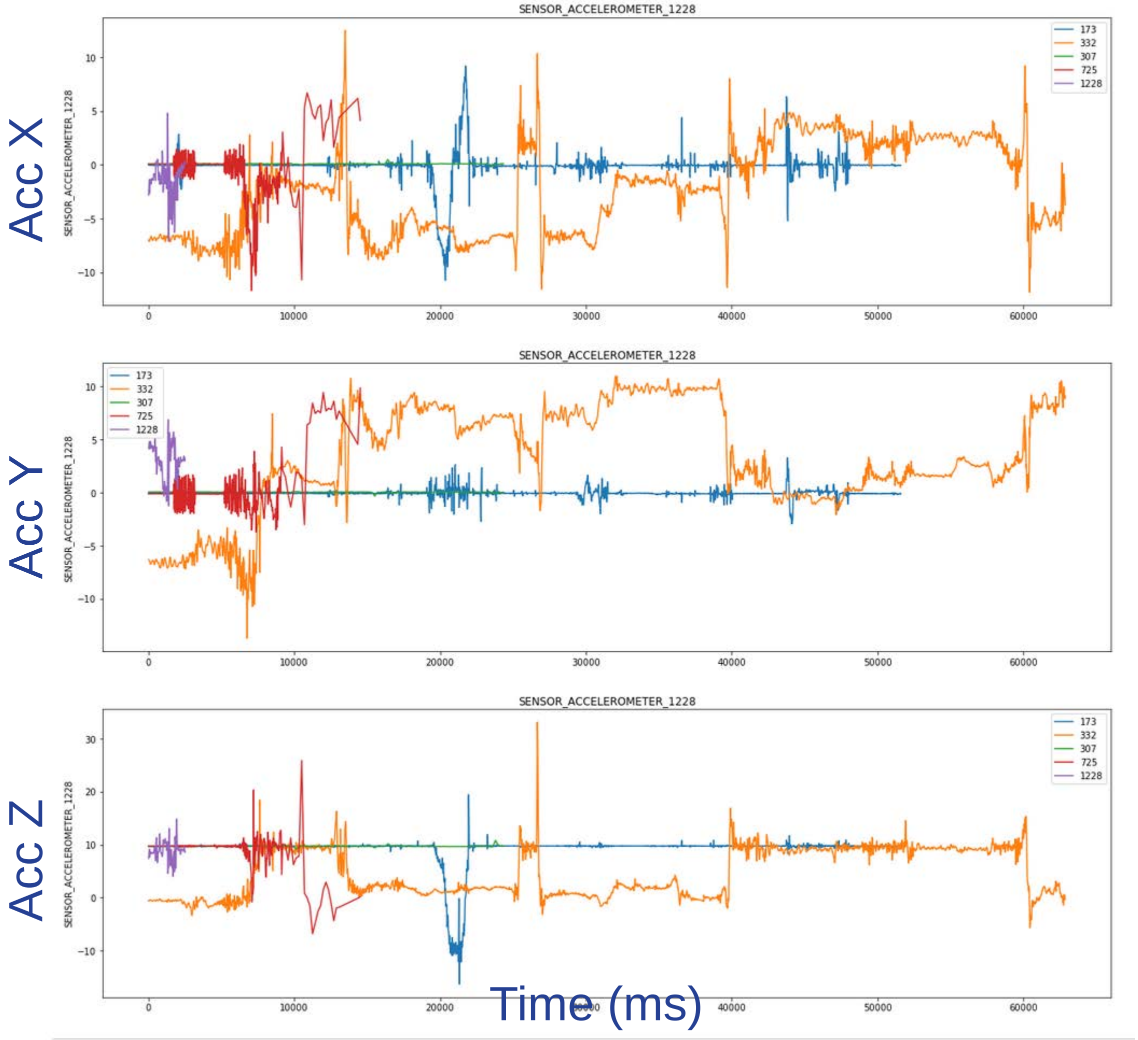
Use case 2 B: Session (call) drop by Smartphone logs

- Csaba Sidló
- Mátyás Susits
- Barnabás Balázs

Logging app and time series sample for illustration

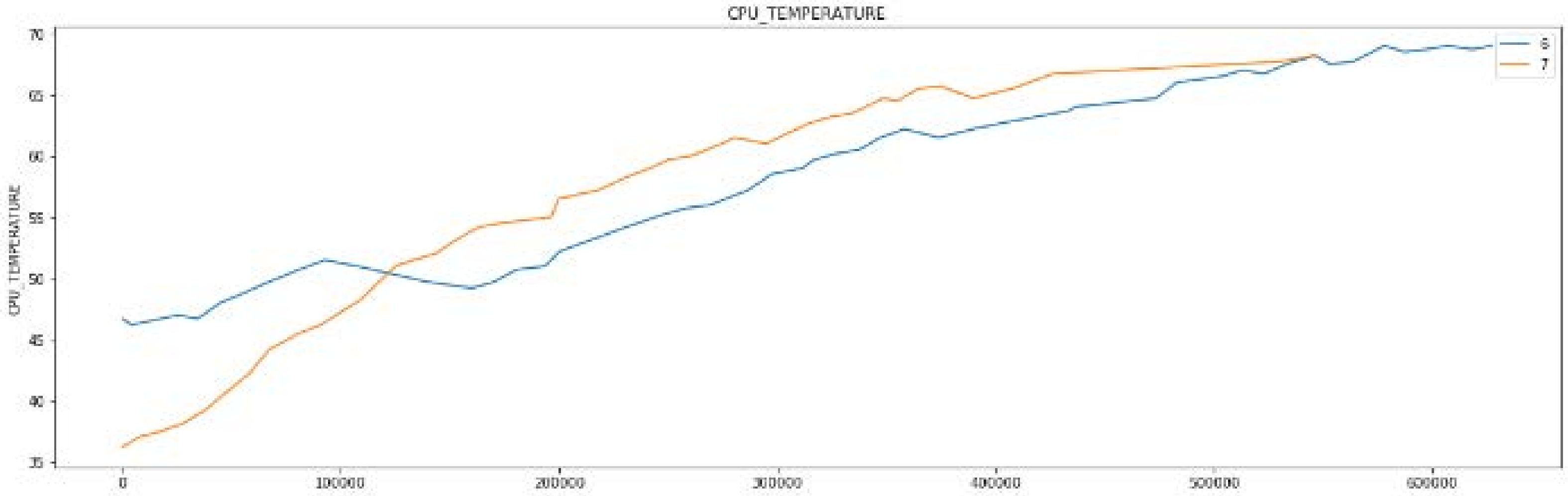


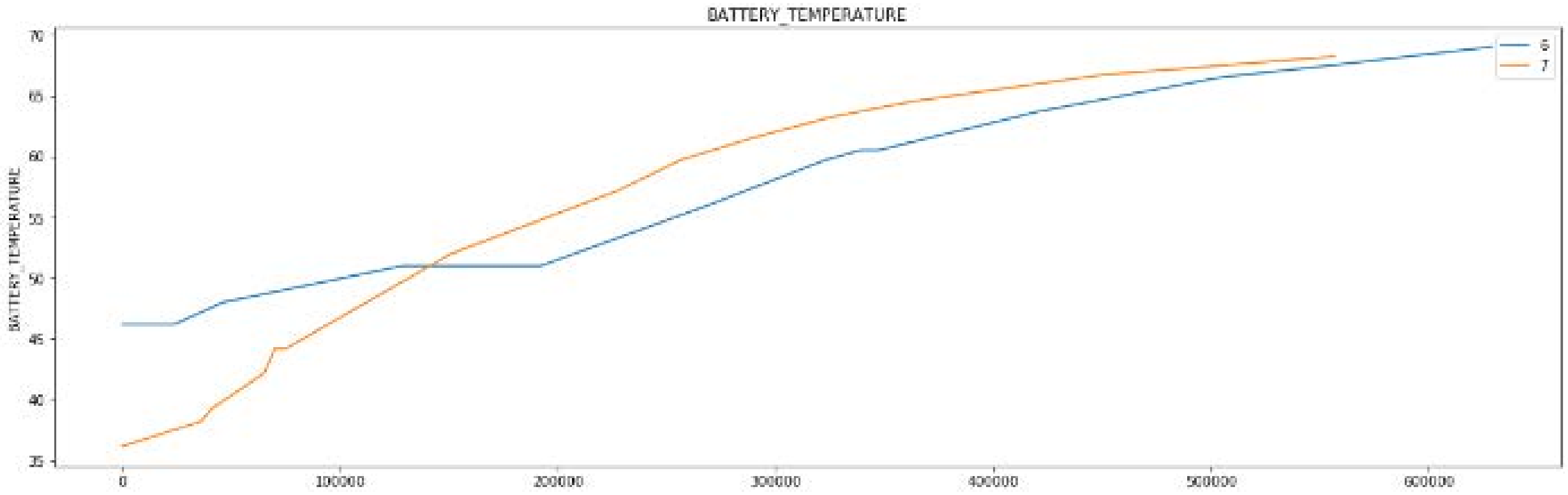
Accelerometer, 5 different devices



Overheated phone test until turn off

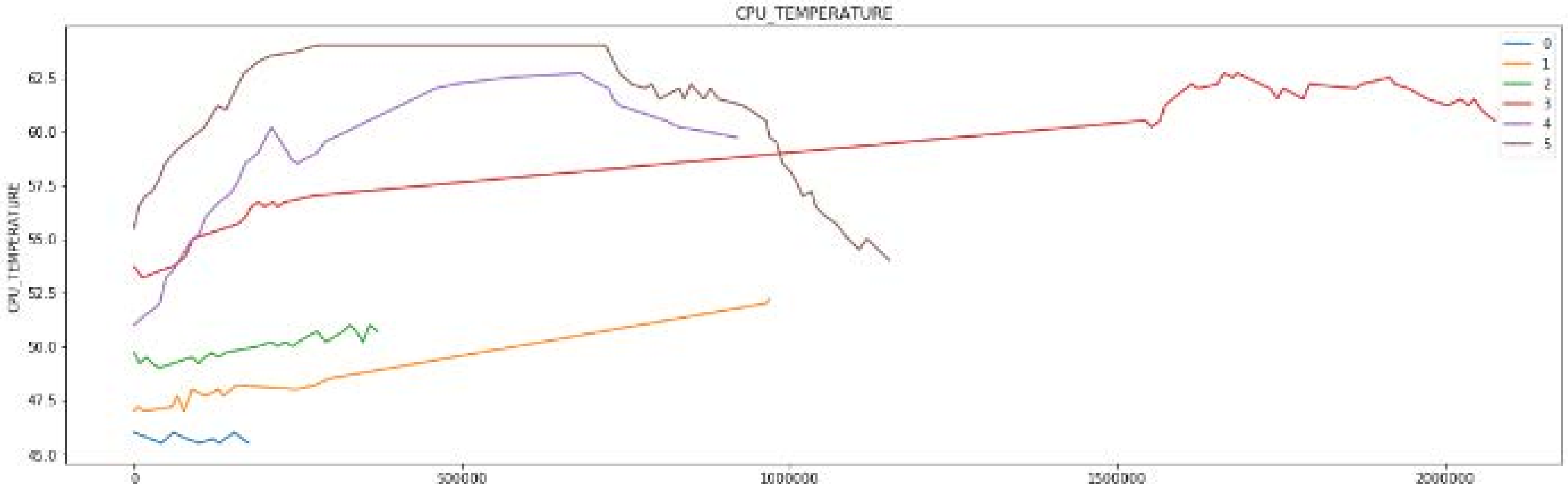
Heating until drop
(by CPU load + lamp)
Drop at 70C

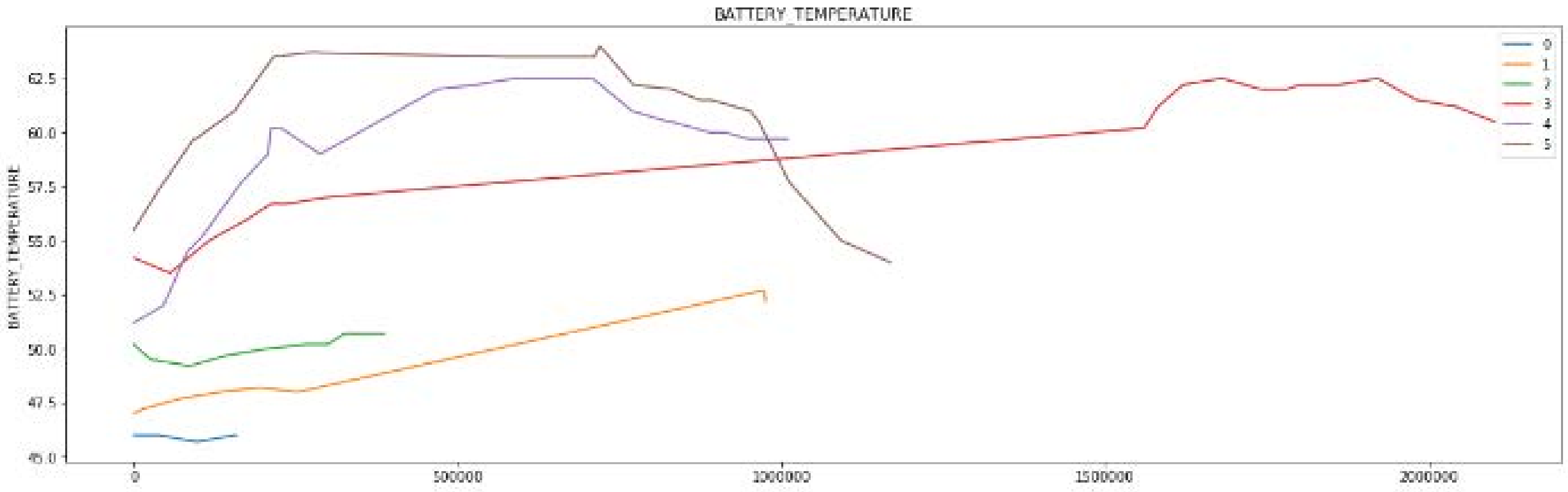




Overheated phone test until turn off

Normal calls
still up to 65C





감사합니다!

Thank You!

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Kérdések?